WARWICK
THE UNIVERSITY OF WARWICK

Original citation:
Kuzemko, Caroline. (2016) Governing for sustainable energy system change : politics, contexts and contingency. Energy Research & Social Science, 12 . pp. 96-105.

Permanent WRAP URL:
http://wrap.warwick.ac.uk/85602

Copyright and reuse:
The Warwick Research Archive Portal (WRAP) makes this work of researchers of the University of Warwick available open access under the following conditions.

This article is made available under the Creative Commons Attribution 4.0 International license (CC BY 4.0) and may be reused according to the conditions of the license. For more details see: http://creativecommons.org/licenses/by/4.0/

A note on versions:
The version presented in WRAP is the published version, or, version of record, and may be cited as it appears here.

For more information, please contact the WRAP Team at: wrap@warwick.ac.uk

warwick.ac.uk/lib-publications

Energy Research & Social Science 12 (2016) 96–105

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

Governing for sustainable energy system change: Politics, contexts and contingency

Caroline Kuzemko*, Matthew Lockwood, Catherine Mitchell, Richard Hoggett

Energy Policy Group, University of Exeter, United Kingdom

ARTICLE INFO

Article history:
Received 10 June 2015
Received in revised form 14 October 2015
Accepted 10 December 2015
Available online 31 December 2015

Keywords:
Energy and climate governance
Sustainable innovations
Ideas
Institutions and interests
Profound institutional change

ABSTRACT

This paper offers a new, interdisciplinary framework for the analysis of governing for sustainable energy system change by drawing together insights from, and offering critiques of, socio-technical transitions and new institutionalist concepts of change. Institutions of all kinds, including rules and norms within political and energy systems, tend to have path-dependent qualities that make them difficult to change, whereas we also know that profound change has occurred in the past. Current decisions to pursue climate change mitigation by dramatically changing how energy is produced and used depend to some extent on finding the right enabling conditions for such change. The approach adopted here reveals the highly political and contingent nature of attempts to govern for innovations, how political institutions mediate differently between forces for sustainable change and forces for continuity, as well as specific interactions between governance and practice change within energy systems. It concludes that it is only by being specific about the contingent nature of governing for innovations, and about how this affects practices in energy systems differently, that those of us interested in sustainability can credibly advise policy makers and drive for greater change.

© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

1. Introduction

This article presents a broad framework for analyzing processes of governing for sustainable energy system change at the national level. Given the global nature of climate change as an issue area much policy and academic focus has to date been on complex processes of agreeing and setting international targets. Governance targets that have been agreed, for instance on reducing greenhouse gas emissions, were put in place in order to achieve a 2 °C limit to global temperatures rises from pre-industrial levels. However there is mounting recognition that the 2 °C target may not be sufficient,[1] that it may not even be met, and that international targets are only *one part* of the governance answer. Indeed what is needed now is analysis that helps us along the road to a far greater understanding of governing for climate mitigation at the national level, its various possibilities and constraints (see [46]).

In its current guise the aim of much national level climate governance is to meet greenhouse gas emissions targets by transitioning away from centralized, fossil fuel based energy systems through sustainable energy innovations. Specifically, energy sector targets have been set and new policies have been chosen in order to enable low carbon energy production and reduce demand. What is becoming apparent, however, is that despite the tendency to focus on these particular energy innovations energy systems exhibit different degrees and types of change. For example Denmark and Germany have both tended to view renewable energy as the preferred form of low carbon generation, managing to substantially increase renewable generation which, in turn, is also decentralized and owned by smaller groups within society [5]. The UK, by contrast, considers nuclear power to be a sustainable energy source, has enabled relatively less new generation from renewable sources, whilst almost all renewable energy production is owned by large corporations (see [82,23]) This prompts the question of why pathways of change have been so divergent even among developed countries given that change is in response to the desire to mitigate for climate change via sustainable energy innovations.

This can be explained by observing that countries make different governance choices as part of the highly complex, and in some senses unprecedented, process of enabling profound energy system change whilst also ensuring affordable and secure energy services. What is needed, therefore, is an explanation of why governance varies, under what conditions and with what implications for sustainable energy transitions. We draw here on insights

* Corresponding author.
E-mail address: C.Kuzemko@exeter.ac.uk (C. Kuzemko).

[1] This recognizes the COP21 agreement reached in Paris in December 2015, where countries agreed to aspire to limit warming to 1.5°.

http://dx.doi.org/10.1016/j.erss.2015.12.022
2214-6296/© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

from socio-technical transitions (STT) literatures, about how complex energy systems operate and change, and from sociological institutionalist concepts about political institutions, policymaking processes and change. STT concepts help us to bear in mind that energy systems are made up of multiple, inter-connected areas, that innovation is crucial to sustainable change, whilst also arguing that (the right) governance is important in enabling sustainable innovations. We, however, somewhat problematize these insights by arguing that governing for sustainable energy innovations is contingent both upon broader domestic political institutions as well as on indigenous energy resources. Different configurations of political institutions and energy resources will tend to influence *types* of governance choices made and, therefore also, the nature of changes that take place in energy systems.

This allows us to focus our analysis on the ways in which different domestic contexts inter-relate with energy and climate governance, as well as to explore the ways in which choices made then enable or constrain sustainable energy system change. This approach can offer answers to some of the research questions raised by Sovacool [77] in his introductory article to this journal, in particular questions 51, 54, 57 and 59 that are about types of politics and forms of governance and how they interact with outcomes, such as sustainable transformations, in energy systems. However, it does so in a way that reveals and explains some of the nuances contained within understandings of what is 'optimal' in terms of energy system outcomes and why.

This paper proceeds as follows: the next section draws on STT literatures to offer up important insights into how complex energy systems work but also how they transition, and the theoretical role of governance in enabling sustainable change. The next sections apply insights from new institutionalism to reveal the many ways in which different political institutions influence governance choices made. The last section brings these insights together and offers up a broad, inter-disciplinary framework for the analysis of governing for sustainable energy innovations that highlights the many and complex inter-actions between relevant areas involved within processes of change.

2. Socio-technical systems and transitions

STT is a broad, inter-disciplinary academic approach, aspects of which have also been applied to innovation policy in some countries [42]. It has been informed over time by studies of science, technology and innovation, environmental and evolutionary economics and by the history and sociology of technology ([73]: p. 471; [51]: p. 957).

2.1. Socio-technical fossil fuel systems

Within STT literatures socio-technical systems are understood as being made up of a wide range of analytically separable but dynamically inter-related areas—for example user practices, the environment, infrastructures, technology, corporate groups, civil society, institutions and politics ([19]: p. 2262; [62]: p. 16). Each socio-technical system has its own complex configurations between these areas that together make up an entire system of consumption and production—thereby directly relating technological functions to the delivery of social needs and practices ([76]: p. 436; [51]: p. 956). Any given socio-technical system is, in addition, likely to actively inter-relate with and provide a context for other socio-technical systems ([19]: p. 2262). For example fossil fuel and transport systems have been intrinsically inter-linked historically and practices in each area have tended to both influence and support certain, carbon intensive, practices in the other. As such they can be understood, when taken together, as making up one broader area in which powerful path-dependencies have arisen that have so far tended to constrain sustainable changes.

According to one prominent STT framework, the multi-level perspective (MLP), energy systems are understood as 'regimes' that interact in practice across and between two other levels: the 'socio-technical landscape' and 'niche innovations'. These levels are taken as heuristic, analytical concepts that help to explain both how systems operate and how they change ([24]: p. 399). The landscape level represents the 'external structural context' for the regime level and is made up of social and physical factors such as broad political coalitions, socio-cultural norms, paradigms, and economic growth ([24]: p. 400; [76]: p. 440). The niche level, as will be further explained below, is highly significant in that this is where radical innovations, which can pioneer new ways of constituting and satisfying social demands, are understood to emerge [40,24].

The regime, which constitutes mainstream ways of realizing various social functions, sits between landscape and niche levels and provides the 'selection environment' for new technologies and other innovations ([76]: p. 440). The energy regime incorporates not just 'technological regimes', consisting of the routines of engineers and firms [56], the 'rule-sets' of complex engineering practices, skills and product characteristics embedded in institutions and infrastructures [61], but also the rules and practices of other groups, including: 'energy users, policy makers, societal groups, energy producers, capital banks etc.,' ([21]: p. 1259–60). These sets of rules and practices tend to stabilize existing trajectories and other regime members but also, importantly, blind actors to new developments outside their focus ([24]: p. 400). One analysis focuses more on corporate elements of regimes by locating certain actors in 'industry regimes', which are 'a set of industry-specific institutions. . .that enable and constrain behavior and action' ([83]: p. 37). These actors are influenced by developments in the economic environment, for example supply chains and markets, and the socio-political environment, such as relationships between industry actors and policy makers, civil society and the public. Industry actors also importantly act to influence these developments via economic, innovation and political strategies, including lobbying, and public relations.

What this definition of an energy system offers is overt recognition of the path-dependent nature of regimes as well as of the wide range of actor groups that are involved within energy systems and of their active and ongoing inter-connections – a point to which we return below in Section 4 when laying out our framework for theorising governance and innovation within energy transitions.

2.2. Socio-technical transitions

Despite such path dependencies transitions are nevertheless possible, and historically have been achieved on a number of occasions - including in energy systems [59,18]. A socio-technical transition is described as a large-scale transformation within society during which the structure of the socio-technical system fundamentally changes. Transitions are made up of sets of interconnected changes that reinforce each other but, as with conceptualisations of regimes, also take place across and between several different areas and levels ([62]: p. 2). Transitions, furthermore, often take place over considerable periods of time, for example one analysis of transitions in the UK, over the past 200 years, observes that it took on average 150 years for new technologies and services to emerge and to diffuse ([18]: p. 6592). This last observation is important when thinking about sustainable energy innovations as part of the process of mitigating for climate change within temporal constraints, and about the degree of urgency that these constraints imply.

In terms of conceptualizing how change takes place the emphasis tends to be on the potential for emergent technological

innovations, which enable new social practices, to challenge and replace existing regimes. Technical innovations are, however, novelties and are 'initially unstable... configurations' which is why niches need to act as 'incubation rooms' protecting novelties against mainstream market selection until they are ready to compete [40]. Technologies still in the niche phase tend, furthermore, to have poor technical performance and to be relatively expensive. In this regard a long-term commitment to research, development and demonstration (RD&D) is considered vital to their long-term viability and success (see [38]). Niches can be understood, therefore, as having the potential for revolutionary socio-technical change ([76]: p. 440). One specific instance in which niches can break through is if external landscape developments simultaneously 'create pressures on the regime that lead to cracks, tensions and windows of opportunity' ([22]: p. 495; see also [41]). An example of this is new scientific knowledge about climate change putting sustained pressure on current regimes of energy production and consumption to change.

Sustainable energy transitions, to the extent that they are taking place, have been described as involving changes to societal practices of energy use; innovation and deployment of a range of low carbon technologies; and a broader change in the mix of industries within national and global economies ([19]: p. 2258). Such changes infer not only new production and consumption patterns but also that different social groups, for example new energy companies, producers, distributors and retailers, will benefit from the process of transition whilst others may face substantial losses ([18]: p. 6591). As Meadowcroft puts it:

conflict is often rife with technological development with economic rivals disputing the course of development and resistance coming from those on whom the costs of change are to be imposed (lost jobs, environmental externalities, regional decline, and so on) (2005: 488)

With regard to high-carbon, fossil fuel energy regimes some incumbent actors, given the vast scale of capital sunk in existing systems, have tended to pitch their, often not inconsiderable, assets at resisting change - or at least at influencing what kind of change takes place ([18]: p. 6592). In the face of this resistance radical new technologies can have a hard time breaking through because pre-existing rules, regulations, infrastructure, user practices and supply chains can tend to align to support and enable the continuity in technological systems [84,23]. We are interested in questions of what political conditions allow for resistance to be successful in constraining sustainable change—and return to this in section 4 below.

2.3. Governance and transitions

Historical studies of system transitions claim that technological innovations and market actors have been the main drivers of change [18], albeit one extensive study claims that governance has been important in distributing the benefits of new technologies more broadly across society [59]. In today's sustainable energy transition, however, the role of deliberate attempts to create rules, incentives and institutions to actually initiate and drive the transition is considered distinctive. As Markard et al. put it "(o) ne particularity of sustainability transitions is that guidance and governance often play a particular role" ([51]: p. 956). These conceptualizations of sustainable energy transitions as purposive set the current sustainability transition apart from previous, less directed energy transitions, indeed one recent scholar has claimed that this is the first transformation in history that has to be achieved "purposefully and against a deadline" [67].

The heavy inference here is that governance matters to the success of sustainable energy transitions. STT scholars tend to focus on the need for political interventions, such as feed-in-tariffs for generators of renewable energy, to nurture and shield technological innovations until they are ready to emerge and disseminate [40,74,60]. Recent scholarship has suggested that "politically-inspired" regime destabilization may also be necessary to create opportunities for the wider diffusion of renewables given that, in practice, they face heavy resistance from existing regime actors ([23]: p. 37). This infers that successful governance should provide leadership by clearly articulating the scientific consensus about environmental pressures as well as providing long-term conviction, direction and positively linking technical innovations to prominent socio-political agendas([75]: p. 1496; [60]: p. 5).

STT literatures have therefore done much to emphasize the importance of governance and to outline possible, albeit broad, roles but it has its limitations in application to an analysis of governing for sustainable energy transitions. One prominent scholar has recently suggest that there has been too much emphasis on enabling niche actors within green energy transitions and too little consideration of regime actors and their abilities to influence energy governance ([23]: p. 23). Geels has also referred to certain political practices and institutions as *part of* energy regimes ([21]: p. 1259–60), but politics otherwise seems to take place rather amorphously at the exogenous 'landscape' level. There is little sense of the context within which governing for sustainable transition takes place, of power relations between the relevant actor groups, or of whether and how some actors are more influential than others over governance decision-making processes. Furthermore, although STT theories allow for a constitutive role for culture, interpretive frameworks, historically embedded norms and power structures, more needs to be done to understand how they affect policy choices, rules, regulations and outcomes (see also [51]: p. 956; [70]: p. 710; [75]: p. 1508).

A second, but related, limitation is the tendency to focus on prescribing policies, often related to enabling new innovations, rather than questioning the political and institutional *conditions* that make the adoption of sustainability policies likely within certain contexts ([53]: p. 73; cf. [72]: p. 4; [1]: p. 119). Although there is some recognition that policies that effectively enable energy innovations in one culture can dramatically differ from those that work in another, there has been too little attempt to explore *why* this might be the case ([1]: p. 119). Such over simplifications of governing for sustainable innovations mean that all too often, prospects for more diverse, creative and progressive forms of social and political transformation are conflated, in theory and practice, "...into a seemingly amorphous, singular, depoliticized 'way forward'" ([79]: p. 5). As a result, the politics of governing for energy system transformations can come across as being quite straightforward in theoretical discussions, when the reality has been quite different in many countries (see for example [42]).

3. New institutionalist theories

This lack of a more developed account of politics in such theories may be in part because, as Meadowcroft ([52]: p. 486) notes, "...the notion of 'transition' is drawn primarily from literatures on technological change", rather than on politics or sociology. Such omissions are important because "...in evading such issues, it is as if the key questions are simply about whether to be 'green' or not, rather than about the radically different political understandings and actions that underpin these claims" ([79]: p. 4).

3.1. Institutional contexts and why they matter

A good starting point in providing a better account of politics, and what lies behind energy and climate governance decisions and practices, is the 'new' institutionalism that has come to play a central role in political theory over the last 30 years. Like STT this is

not a unified body of thought but comprises a number of different approaches to the analysis of politics and governance ([29]: p. 936). New institutionalist approaches are, however, unified by the notion that institutions, understood broadly as regularized practices underpinned by formal and informal rules, procedures and/or norms, mediate politico-economic relations in multiple but varied ways ([30]: p. 9–10). This section emphasizes, in particular, those approaches that understand policy both as socially constructed and as influenced and structured by sets of ideas and interests [27,4,17,65]. Ideas are understood to have a role both in constituting political action but in "the (re) construction of political interests and values. . ." ([65]: p. 2).[2]

One of the most used explanatory devises within new institutionalism is that of the policy paradigm which not only refers to ideas as explanatory variables but reveals the ways in which ideas can become embedded in formal, and informal, governance practices over time [27]. The importance of ideas in policy-making processes has been explained by proposing them as the link between context and conduct, institutions and behaviors or, in other words, as part of the 'why' of analyzing actions ([31]: p. 953). Indeed, sets of ideas once embedded within formal political processes can mediate between interest groups and influence which voices are 'heard' in political debates and which are not. STT approaches introduced us to the notion of energy regimes as representing set norms and practices at the level of system actors, such as companies and end users of technological services. New institutionalism enables us to focus on policymakers, such as politicians, regulators and civil servants, in order to explore why they make the decisions they do, how they interact with other actors, and with what consequences for sustainable change.

As Hall ([27]: p. 279) observed:

. . .policymakers customarily work within a framework of ideas and standards that specifies not only the goals of policy and the kind of instruments that can be used to attain them, but also the very nature of the problems that they are meant to be addressing. . .

In addition to the ability of the framework of ideas, or policy paradigm, to influence important decisions such as the choice of objectives and instruments of policy it can also influence choices of more precise policy settings (including regulations). Ideas, once accepted, can become so embedded within policy-making processes that they can emerge as orthodoxy, taken for granted, and highly self-referential (ibid: 279; see also [6]). This makes them hard to challenge and infers a degree of path-dependency. In addition to influencing choices of policy objectives, instruments and settings frameworks of ideas can also delimit *who* is deemed appropriate to work within and/or act as expert advisors in policymaking circles ([6]: p. 378, [53]: p. 73). Certain sets of ideas can be dominant within wider society also and some scholars have explored how, in nationally specific ways, policy-makers frame policy ideas to make them palatable to public audiences ([7]: p. 4). Indeed established sets of ideas become knowledge that can then be passed on within society through education and vocational training.

The concept of policy paradigm has often been used to identify and explore the turn from Keynesian to neoliberal forms of economic governance across many OECD countries since the 1980s [27,33,4]. One claim is that, for a decade or so, the liberal market paradigm was the principal context within which energy policy decisions were made and narratives of competition, economic efficiency and liberal markets dominated both climate and energy governance policy decision-making ([57]: p. 6–8; see also [34]). Market liberal ideas prescribed, among other things, particular roles for states and markets in economic governance with the general preference being for a withdrawal of the overloaded state. Indeed OECD and non-OECD countries, sometimes as part of IMF loan conditions, liberalized and often also privatized their energy sectors in order to become, in theory, more competitive and economically efficient. For example, Mitchell's [55] account of the UK energy system argues that UK political institutions have skewed the overall nature of energy governance toward inertia for a decade or so. This includes a reasonably dominant ideological commitment to placing markets rather than government at the center of delivering policy objectives such as energy security and/or sustainable energy system change. Given their size, and breadth of market coverage, this political choice has tended to assign important roles to incumbent energy companies over emergent niches. In this way also energy and economic policy areas have, to some extent and for a period of time, co-evolved and been influenced by similar sets of ideas. In his recent analysis of energy and capital [88] argues that norms reifying the market have allowed for powerful capital interests to influence energy policy and, thereby, to reproduce fossil fuel capitalism.

It is not assumed, however, that all developed economies have become equally market liberal nor indeed that there are no credible contestations of liberal market orthodoxies generally or, more specifically, in energy and climate policymaking circles. One of the most important applications of the new institutionalist theory has been in the exploration of institutional diversity in capitalist economies and the implications for how state market relations are conducted, for the distribution of system costs and benefits, and for equity. Schmidt ([66]: p. 113) notes that in some countries, like the UK, Australia and the USA, governments have the character of a liberal arbiter, with less prescriptive or co-ordinated relationships with the private sector. In other countries, such as Germany, Sweden, Finland and Denmark, governments are associated with social democracy and greater collective and/or coordinative capacities. These are countries where state bodies can engage directly, on an ongoing basis, in shaping the economy ([7]: p. 14; see also [28]). There are other aspects of political institutions that also have relevance when exploring the context within which governing for sustainable energy innovations takes place. Iversen and Soskice [37] argue that the proportional representation (PR) voting system, used in 21 out of 28 European countries, tends to be more representative of voters' wishes and more inclusive of smaller political parties like the Green Party. By contrast, the first-past-the-post system, which the UK still favors, is understood to engender more adversarial and centralized politics ([32]: p. 205), and often results in two-party systems with less room for smaller parties to be influential.

However it should also be noted there are important differences between countries that are labeled as social democracies or as market liberal. The work of Berman [3] shows a marked difference in the evolution of social democratic ideas, and their influence over policymaking, in Germany and Sweden. It should be noted too that there are also important differences in political rules and norms even *within* countries. As we have seen in the case of Denmark very different energy governance decisions can be taken depending upon which political party or coalition is in power, but there can in addition be considerable differences in how particular *sectors* are governed. For example even in countries where market liberal ideas tend to be most influential over policy decision making processes there are some sectors, in particular defence and/or health, that are

[2] Although some within the broad church of new institutionalism argue that the ways in which actors conceive of their interests are influenced (more or less heavily) by institutions and ideas others argue that interests are more fixed and/or material. Certainly many actors will perceive of their interests as material but they may also just be unaware of ideas and institutions that inform and constrict them. There is not the time here to enter too deeply into these debates but for interesting discussions on the relationship between interests and ideas see: [4,32,89].

considered to require high degrees of state involvement (see [11]: p. 441–2). This is a point to which we return in section 4.2.

3.2. Institutions, change and energy

Section 3.1 has argued that frameworks of ideas can become embedded within institutions and that institutions, in the form of regularized practices, rules and norms, influence governance decision-making processes. What we are most interested in here, however, is explaining both governance for energy system change and related processes of change within energy systems. Our interest in processes of governance change is based on the argument, from STT literatures, that greater political assistance is required to enable more innovations, as well as on current arguments about the likelihood of missing the 2 °C warming target [36]. Together these infer that quite considerable governance change is still needed (see also [64]).

Sociological institutionalists, as opposed to their historical institutionalist colleagues, tend to conceptualize governance as dynamic and subject to change over time. There are a number of suggestions about the conditions under which profound governance changes can happen: for example in the event of a significant party political shift as the result of a general election, during times of crisis and uncertainty, or more gradually via an accumulation of new rules and norms over time [27,4,49]. There are some similarities between how STT scholars conceptualize change in socio-technical systems and how new institutionalists understand governance change. Change is enabled, from both perspectives, when there is recognition that a problem exists and that current technologies and/or governance are not addressing these problems ([4]: p. 10; [85]: p. 6). More specifically, there needs to be some form of debate about what the problem is, what needs to change and why. Alternative ideas, if articulated successfully, can play a number of different important roles within such debates - not least by shedding new light on embedded institutions, and associated governance choices, thereby making them more overt and amendable to scrutiny. Alternative narratives, specifically, can not only establish that a problem exists, but they can also offer explanations of why a problem exists, provide proof of failure of existing governance to address these issues, as well as provide new policy solutions and ways of doing things ([43]; see also [33,4]).

This is no easy process and to successfully contest established governance orthodoxies the ways in which new ideas are articulated will need to directly engage with and contest the assumptions underpinning policy-making and they must also gain legitimacy on their own terms ([6]: p. 385). In this way politics can be understood as an ongoing struggle for power and influence played out in significant part through arguments about the 'best story' at any point in time ([17]: p. x).

What is also of note here is that processes of governance change, where existing orthodoxies are contested and destabilized, can be contentious not least because change of a profound nature, as with socio-technical regimes, infers new winners and losers and is, as such, deeply political. Although credible, well-articulated, alternative narratives can drive change there will be those that work to resist change, sometimes through reference to existing rules and norms. In this way the *nature* of change that takes place will be related to the specific battle of ideas that make up debates about how to proceed and to the compromises struck between positions in each country. These debates may take place in elite, policy-making and 'expert' circles only, or may be more open across society [8]. More inclusive change, and thereby potentially with greater societal buy-in, will involve long-term, broad and transparent processes of deliberation [79]. Either way new forms of governance will often be shaped by existing institutions—this is not least because ideas are narrated in relation to that which currently exists but also because change is relative and represents a form of compromise reached between narratives for continuity and for change.

Within energy policy literatures claims have emerged that profound shifts in energy governance have, for some time, been ongoing [34,63,8]. Others have questioned how so much policy change can in some instances lead to so little change of a sustainable nature in energy systems [43]. These analyses, like STT approaches, emphasize the challenge from new scientific knowledge about anthropogenic climate change as a considerable new driving force for change to existing energy governance. What we highlight here, however, is that narratives about energy supply (in) security, often informed by geopolitical ideas, and concerns about declining affordability have also been influencing changes in energy policy objectives and instruments (see [34,25,45]). As such the reality is that energy governance has in most countries, but also in organizations like the International Energy Agency (IEA), become about achieving security and affordability objectives in addition to climate mitigation. If energy governance is to be successful, therefore, it now needs to balance these demands and different countries may prioritize differently between the trilemma of policy objectives. For example the UK has, for energy security and economic growth reasons, recently adopted new policies designed to support greater oil and gas exploration and development and through the new Capacity Market, to reward fossil fuel-fired electricity plants [13]. In this way other, including non-energy, policy objectives can be prioritized over sustainable innovations.

This identification of multiple political drivers for change, and multiple objectives that energy governance is increasingly designed to achieve, tends to reveal the complex context within which governing for sustainable energy innovations takes place. The *nature* of new policies chosen will reflect the push and pull between new ideas about climate change, ideas about the need for energy security and affordability as mediated by the broader institutional context ([45]: p. 200–201). When considering how domestic political institutions can influence processes of governance change for sustainable energy it is worth turning briefly to some comparative analytical work [10,11,54]. Some analyses of relative performances in environmental and climate change mitigation argue that countries with historical tendencies to govern actively toward meeting social goals, such as a sustainable energy transition, have capacities not as readily available to more market liberal economies ([11]: p. 441). Another claim is that countries that are capable of supporting the kinds of welfare policies that, in turn, more equitably redistribute the effects of energy system change will have more of a chance for long-term success [10,48]. This is because more equitable system change can underpin greater societal support for continued sustainability innovations. Furthermore, countries with PR voting systems, that allow for a greater Green voice within formal political organizations, also enable governments to be more goal orientated and to prioritize climate change when devising new energy policies [68,16].

Taken together this paints a somewhat messy, complex and ongoing picture of governance change that is hard to analytically pinpoint—especially when the direction of change is mixed and/or changes regularly. Those countries that find it hard to prioritize climate mitigation over other policy objectives in instances of trade offs, or indeed that do not plan for trade offs, are more likely to exhibit this more messy process of change.

4. Governance and innovations in sustainable energy transitions

In section 4.3 we offer up our new framework for analyzing domestic processes of governing for sustainable energy innova-

tions, but only after we have made some important new points of clarification in sections 4.1 and 4.2.

4.1. Linking governance with practices and outcomes

Applied to theorizing governance for energy innovations, institutionalist theories can tell us more about the contingent and complex *nature* of energy governance and about drivers for change. However, the weakness of new institutionalist approaches, for our purposes, is that they focus too narrowly on the political and policy domains and, as such, tend not to provide methods of exploring links between policy and practice change in energy systems [43]. Here we return to STT arguments that in order to establish sustainable energy systems there need to be profound practice changes, for example in how energy is produced and used. One practical way, however, of linking governance to practices in energy systems is to consider how important industry actors, incumbents and new companies, are influenced by policies and vice versa (i.e., what opportunities do different companies have to influence policy). In order to make these links research needs to move beyond the energy policies and objectives analyzed above to include regulations and market rules, including corporate codes of practice, within the analysis (see also [64]). Our framework, therefore, takes into account the *full range* of governance processes that have a bearing upon corporate practices in the energy system. It is for this reason that we refer to governance, rather than energy policy or regulation specifically.

This may well make analysis more complex but it is based on the recognition that governing for sustainable energy innovations does not exist within a governance vacuum but that, in practice, system actors must respond to multiple policies, regulations and market rules. It is also important to note that some companies, for example those following non-traditional/innovative business models, will respond differently to energy governance than established, incumbent market actors. Indeed, the point we are making is that it is the entirety of energy governance that shapes practices, and whether they change or not, in energy systems. For example in the UK measures, such as the Green Deal and Energy Company Obligation (ECO), were put in place to encourage energy efficiency innovations but their effects on practices in energy systems were constrained by a host of other rules and regulations that tended to incentivize a supply orientation in the energy system as a whole [86]. In effect, therefore, new sustainable energy policies can coexist in practice with pre-existing policies, regulations and rules that drive less sustainable practices. This is partly because pre-existing governance processes were often put in place prior to the adoption of new climate mitigation public policy goals. This can offer us another explanation as to *why* new sustainable energy policies do not necessarily equate in practice to sustainable changes in energy systems [43].

By understanding governing for sustainable innovations as part of a more complex political whole this allows us to question which interactions between governance actors and actors in energy systems are delivering sustainable practice change and which constrain such change. Just as this is true for scholarly research so should this also be true for policymaking analysis. Energy governance and policy-making processes must be regularly measured according to energy system outcomes, sustainable and otherwise, and be flexible enough to change if necessary. One reasonably successful example of this is in Germany where regular adjustments are made to policies and regulations according to energy system outcomes such as falling costs of renewable energy, growth in emissions and/or impacts on electricity wholesale markets of greater quantities of renewable energy [69].

4.2. Defining energy and climate actor groups

We argue further that in order to understand governance for sustainable energy innovations and how it relates to practice change it is also necessary to understand the historical energy landscape: who the important actor groups are, what interests they represent and their relationship to governance. The precise nature of historical relationships between energy actor groups and political organizations will have had implications for choices made at points in time and for the nature of energy governance institutions (rules and norms). Indeed, one recent analysis of energy system change has argued that there has been too much focus in STT analyses on niches as enabling innovations to emerge and too little attempt to differentiate between actors within processes of change and analysis of regime resistance ([23]: p. 23). Whilst we concur with this observation our approach, as outlined in section 3, tends conceptualize the politics of governing for sustainable energy innovations as being in part about multiple actor groups, forces for sustainable change and for continuity, how they compete within debates about sustainable change and what compromises are struck. This involves differentiation between actors groups, but also a consideration of which specific actor groups are involved in seeking to influence policymakers during change debates, what their arguments are and how these are mediated by political institutions.

In section 2 it was explained that sustainable energy system change has profound implications for a number of inter-connected energy regime actors: oil, gas, electricity (generation and supply) and associated supply chains. As a reminder, profound shifts in the energy system toward sustainability imply new 'winners' and 'losers' and those that stand to gain or lose out will be at the heart of change debates. In some countries it has been observed that regime actors, in the form of incumbent energy companies, tend to act as forces for continuity and new innovators act as forces for sustainable change [78], but this is not always the case. Actors groups will seek to influence governance and to inform and/or control the terms of debate about system change. Their ability, however, to be influential will depend, as already discussed, on domestic political institutions and inferred power relations (see also [23]). We argue that what also needs to be considered when understanding incumbent regime actors, and their ability to be politically influential, is the historical economic and political importance of the industries they represent. Fossil fuels are geographically fixed, geologically finite and have been unevenly distributed within a world still delineated according to sovereign states [26,57].[3] Furthermore, it has made material historical difference to countries if they have had access to indigenous fossil fuels whilst energy companies have over time made considerable financial contributions to GDP and have employed large numbers of people. Indeed, because of the material importance of fossil fuels to economic development in the 19th and 20th centuries, some scholars have linked generous domestic endowments of coal and oil to global economic power and influence [80], partly also explaining why fossil fuels have so often provided reason for conflict [50]. Countries without such natural endowments, conversely, have often had to establish political and economic networks of access to vital fossil fuels and have also been more vulnerable to energy crises such as the 1970s oil shocks.

It is partly for these reasons that countries with long-standing fossil fuel industries and/or which are still to an extent economically dependent on fossil fuel income streams tend to privilege the narratives of these important actor groups. Here embedded institu-

[3] Even the EU, despite decades of attempting to liberalize energy, recognizes the sovereign right of member states to 'determine conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply' ([15]: 135).

tions will reflect economic reliance on fossil fuel industry incomes and there may be strong (formal) relationships with policymakers (see [58]). Formal political organizations, such as government departments, may have long histories of working to maintain the supply orientation of energy systems in line with historic energy industries, including also nuclear. Actor groups representing these industries can often mobilize considerable financial and knowledge capital behind influencing the terms of media and political debates emphasizing the need to innovate in ways that will ensure their survival [18,23]. Given the extent to which conventional energy regimes are economically important their arguments can be convincing to both elite and some public audiences. As such it is understandable that some governments still actively support conventional energy regimes in myriad different ways [35], as well as support technological innovations like Carbon Capture and Storage (CCS) designed to improve rather than profoundly alter current energy systems [60].

It is also important to note however that some countries without, or with less access to, indigenous fossil fuel resources have longer histories of making their energy systems sustainable. Some scholars note that oil importer countries, such as Germany, Sweden and Denmark, responded more strongly to the 1970s oil shocks, partly by making their economies more energy efficient but also by starting to encourage renewable energy generation [25,14]. Denmark, for example, responded with an aggressive drive to improve efficiency (partly through district heating and CHP) as well as pursing wind power. Consistent and planned support for such innovations has meant that niches have had longer to develop and to diffuse more broadly. Sometimes this has required firm governance decisions to privilege sustainable innovators over those arguing forcibly against specific sustainability policies—for example in Germany in the late 1990s [38]. Indeed, as sustainable energy companies grow in number this can lead to new energy lobbies, also representing large-scale employment, ultimately allowing forces for sustainable change to gain momentum. The ability to actively nurture multiple, small innovations and encourage their growth more closely exemplifies a marrying together of top down governance with bottom up drivers/possibilities for change [79].

Finally in this section it should be noted that forces for continuity in energy systems and forces for sustainable change do not only include corporate actors but represent much broader coalitions. Forces for continuity can include independently influential groups such as banks, pension funds and other associated supply chain actors with sizable investments in energy regimes. They can also include climate sceptics, politicians and energy consumers, large and small, particularly those focused on the cost of energy over other factors (see [23]). Forces for change can be equally diverse (see [38]: p. 259). It is worth noting up front that, under certain circumstances, incumbent energy companies can become *part of* the process of change, as has been the case in Denmark and Portugal ([47]: p. 102). Coalitions for sustainable change can also include climate scientists, technology experts, NGOs, politicians, policymakers, international organizations, and consumers/voters for whom environmental sustainability is important. They increasingly also include investors in the form of the recently successful, UN backed, divestment campaigns like Fossil Free UK. What unites this broad coalition is the drive for sustainable change but there is considerable diversity visible in the broad, but not always commensurable, range of solutions offered.

4.3. framework for explaining varied governance and system change

We set out here our tentative conceptual framework for analyzing governance for sustainable energy system change, and the contexts within which such processes take place (see Fig. 1). As promised the framework brings insights from new institutionalism, about political institutions and their relationship to policymakers and policy choices, with STT insights about regime and niche actors and about the vital need to link governance with practice change in energy systems. In an attempt to be specific about governing for sustainable energy system change we include forces for sustainable change and for continuity within the framework given that analytical focus on these groups will tell us much about the precise terms of change debates in different countries. To be clear the box marked 'political institutions' includes a broad spectrum of the domestic political context, including formal and informal rules and norms that have influenced the type of voting system as well as the breadth of welfare provision. In addition political institutions are taken here to include assumed hierarchies between economic, energy and climate policy objectives, and how energy, and climate, policymakers and market actors should inter-relate in the pursuit of energy goals. For example norms guiding important questions around whether change should be market led, with government taking an incentivising role, or whether government should take a leadership and co-ordinating role through goal oriented governance.

What we have tried to make evident in Fig. 1 is the highly interconnected character of relationships between the different areas whilst it is also assumed that inter-connections in all instances work in both directions. Forces for sustainable change and for continuity will utilize different narratives to influence energy policymakers and governance decisions, and again these debates will vary according to political context and indigenous energy resources. This, in turn, influences the nature of energy governance, including hierarchies between policy objectives, choices of instruments and regulations, market conditions for regime and niche companies and, therefore, practices and outcomes. Ultimately, of course, energy system change happens when practices change but we emphasize here the deeply political nature of such change in an attempt to explain the different choices made in pursuit of sustainable change and the forces ranged against it. New practices, as they become more established over time, will provide new forces and narratives for influencing governance for sustainable innovations. What this helps us to understand is the complexity and degree of contingency of governing for sustainable energy innovations and *why* there is such variety in energy and climate governance and in sustainable energy system changes in practice.

4.4. Governing for sustainable energy system change: Germany and the UK

Given the space already taken here in explicating our framework there remains sadly little room to apply the framework, and this is work to which the authors intend to return in more detail in future articles. What we can do here is briefly explain two different governance processes, in the UK and Germany, in the light of our framework.

As observed in the introduction to the paper the UK has managed comparatively lower amounts of sustainable practice change in energy systems in terms of renewables as *a percent of energy consumed*, in terms of decentralizing supply and energy efficiency. But it also still actively supports fossil fuel regimes through the Capacity Mechanism and through new policies to enable maximum possible extraction of North Sea oil and gas as well as a new shale gas industry (see [13]). One explanation given is that institutionalized, market liberal, ideas that suggest a limited role for the state have tended to work in practice against pro-active government leadership and support for sustainable energy system change. Scholars have observed that market liberal ideas have influenced energy policymaking bodies in such as way as to narrow down the range of acceptable policy options in response to climate change with the emphasis being on market-based instruments [55,71,63]. This

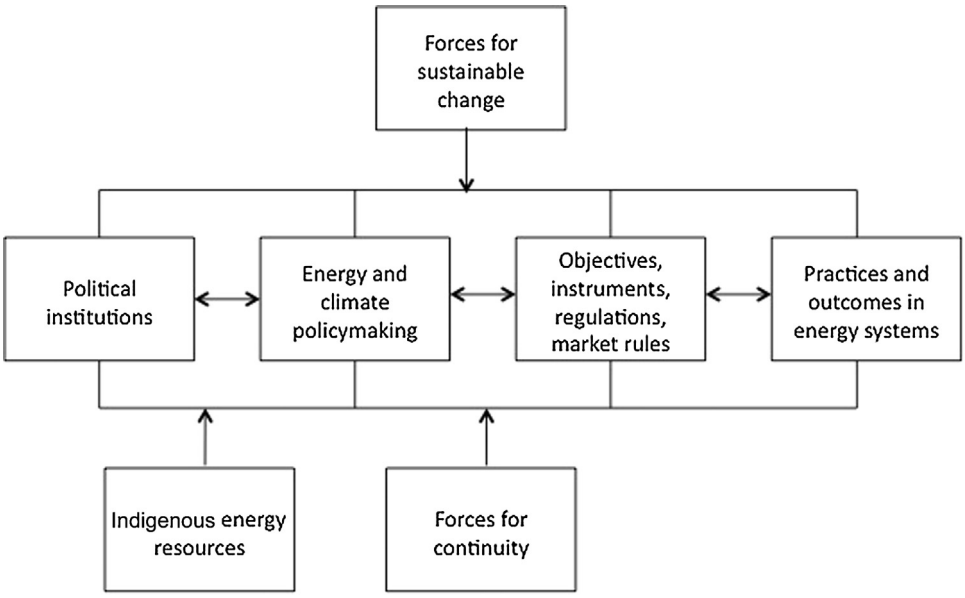

Fig. 1. Interconnections within processes of governing for sustainable energy transitions.

has also served to restrict the role of governance to 'temporary interventions' followed by a withdrawal of government involvement once 'market failures' have been fixed [12]. Market liberal institutions have also resulted in a form of governance wherein there has been a higher degree of delegation of responsibility to regime actors and less activity to co-ordinate market actors toward meeting legally binding climate targets.

An application of this framework, however, allows us to take domestic political institutions, such as market liberalism, into account whilst also considering the relationship between relevant actor groups and policymakers. We would highlight the economic importance historically of the fossil fuel industry and the, related, long-standing relationships between UK energy policy makers and regime actor groups as being analytically important. At the risk of stating the obvious it should be noted that UK fossil fuel regime actors have tended not to argue strongly for sustainable energy system change nor have they led the way in sustainable innovations. In effect these formal and informal relations have allowed for a greater degree of influence of forces for energy system continuity over energy governance whilst new actors seeking to develop sustainable innovations, such as energy service companies (ESCOs), community renewables schemes and demand aggregators, have found it relatively harder to enter markets (see [87,44]). The tendency to listen to important energy regime actors and the preference for system continuity over change might also explain why the UK has chosen, despite its vast costs, to support nuclear as a 'low carbon', domestic source of electricity. It might also help to explain why it does not have targets for energy produced from renewable sources beyond 2020.

This is not to say that climate mitigation and energy system change have not been on the political agenda nor that there has been no debate about sustainable energy system change. Indeed the UK adopted the Climate Change Act in 2008, a groundbreaking piece of legislation given the legally binding nature of its emissions reduction targets, as well as policies designed to enable energy efficiency and renewable energy. The argument here is that there are so many other aspects of the energy system debate, for example energy regime actor groups emphasizing the importance of domestic energy supply security, that sustainability tends to lose out in practice. Arguments for sustainable change are also sometimes trumped by market liberal institutions that recommend near-term economic efficiency, as in the current narrative of fiscal austerity that has very recently led to a withdrawal of some support for onshore wind and solar as well as reduced welfare provision. In addition, many pre-existing energy regulations and rules, such as the extensive set of corporate codes and licences, were enacted before climate mitigation became a political concern and still do not have any sustainability mandates built in. These corporate codes, as has been recently observed by the UK's Competition and Markets Authority as part of their Energy Market Review, tend to stifle innovations in the form of new market entrants [9]. Taken together this is a more exclusive form of energy governance that sends, at best, mixed signals about how energy markets should change and which has not yet provided conditions for innovations to grow sufficiently nor for wider publics to become involved in and benefit from system change [79].

Energy system change in Germany has taken a different course not least in terms of the rate of renewable energy growth and the distributed nature of its energy transition [5,39]. As already suggested some scholars claim that German political institutions allow for more coordinative, and goal oriented relationships between policymakers and energy system actors. New institutionalist scholars suggest that Germany's political economy is not 'market liberal' in nature, but has historically been more influenced by sets of ideas about ordoliberalizm and by a version of social democracy [3,2]. Both these sets of ideas allow for a 'strong state' and a more active role for government actors in determining socio-economic outcomes, such as setting and meeting strict sustainability targets. The PR voting system has allowed not only for greater Green representation in the Bundestag and some regional administrations, but it has also required political actors to co-ordinate with other important groups within government coalitions. As Schreurs [68] argues, German Green political support has been vital in underpinning sustainable energy governance decisions over the past decades, not least in the decision to phase out nuclear power.

It is also notable that, partly in response to events of the 1930s and 1940s, the German Federal system devolves political authority more widely away from the center to the regions, or Länder. What this has resulted in is more capacity at the regional and local municipal levels to support and enable the distributed nature of energy system change. An application of our framework also brings historical energy infrastructures to light in explaining differences

in energy transitions. It is notable that Germany, unlike the UK, did not nationalize and centralize its energy system in the post-WWII period [5], and as a result pre-existing gas and electricity infrastructures were more municipal based and supportive of the distributed energy revolution. Again unlike the UK, forces for sustainable change have also not had to contend with big domestic, but globally influential, oil and gas regime actors.

This is not to say that there has not been strong opposition to sustainable energy system transition. Germany's long-standing coal industry still employs a not insignificant number of people and industry lobbies have formed a significant element of the debate about how to transition German energy systems. Indeed, the coal industry makes up only one part of the broad coalition for continuity in Germany, which also includes the 'Big 4′ gas and electricity companies and some groups representative of heavy industry. Together they have mounted, and continue to mount, sustained attacks on green energy policy decisions [38,20]. Indeed, various industrial groups have been sheltered from the costs of change, including large-scale energy users, whilst the coal industry has so far had a relatively easy time of it.

But because political institutions have allowed for relatively more support for green innovations, with less distraction from the need to also govern in support of oil and gas industries, this has resulted in an accumulation of the forces for sustainable change. As new energy innovations have become more widely distributed within the economy and society there is more buy-in to change as well as improved knowledge about how to build sustainable systems in practice [81,48]. The tendency to allow for social learning within energy systems is to some degree matched by the willingness of German policymakers to adapt policies and regulations as market conditions change, for example regular revisions to FiT support levels as the cost of different renewable technologies fall [69]. Lastly, welfare policy directly supports vulnerable energy users by paying for heating thereby making the effects of system change more equitable and reducing opposition on fuel poverty grounds.

5. Conclusions

Following Sovacool [77], we have introduced here a framework for analyzing sustainable energy system transitions that places governance in a central position and which also explains how domestic political institutions and historical energy infrastructures can differently influence the nature of change. We have drawn out two broad lessons useful to those of us interested in greater understandings of how sustainable energy system change occurs. The first is that a too narrow focus on governance will tend to result in analysis that can identify policy and regulatory changes clearly, but will have too little to tell us about how practices in energy systems are responding to those governance changes. The second is that there is a need to be precise about the domestic political context within which processes of governing for sustainable change take place. Indeed, what we have tried to make clear here is that change is differential precisely according to the variety of ways in which embedded institutions and indigenous energy infrastructures inter-relate with forces for sustainable change and for continuity. What this means is that interdisciplinary analysis, although often difficult to pursue, can indeed provide us with a more nuanced and inter-connected account of types of governance and of energy system change.

The question that emerges from these observations is, however, whether certain countries are predestined to lag behind others simply because of the types of institutions and energy regimes upon which their political systems have been built? This would certainly be a bleak proposition given the degree to which current attempts to mitigate for climate change are temporally constrained. However, it can also be argued that it is in understanding the nuances and complexities of individual country governance for sustainable energy transitions that we can identify precise impediments to change. It is only by being specific about which aspects of governance tend to constrain rather than enable sustainable changes that we can better communicate what needs to change, and what the solutions should be, in ways that are tangible to elite and wider audiences.

Acknowledgements

We would like to thank The Engineering and Physical Sciences Research Council (EPSRC) [EP/K001582/1], for their support in making this article possible, as well as the four anonymous reviewers for their in-depth and insightful comments.

References

[1] K. Araújo, The emerging field of energy transitions: progress, challenges, and opportunitiesemerging field of energy transitions: progress, challenges, and opportunities, Energy Res. Soc. Sci. 1 (2014) 112–121.
[2] V. Berghahn, B. Young, Reflections on Werner Bonefeld freedom and the strong state: Germany ordoliberalism and the continuing importance of the idea of ordoliberalism to understand Germanys (contested) role in resolving the eurozone crisis, New Polit. Eco. 18 (5) (2013) 768–778.
[3] S. Berman, The Social Democratic Movement: Ideas and Politics in the Making of Interwar Europe, Harvard University Press, Harvard, 1998.
[4] M. Blyth, Great transformations: Economic Ideas and Institutional Change in the Twentieth Century, Cambridge University Press, New York, 2002.
[5] C. Burger, J. Weinmann, Germany's decentralized energy revolution, in: P. Sioshansi Fereidoon (Ed.), Distributed Generation and Its Implications for the Utility Industry, Academic Press, Oxford, 2014.
[6] J.L. Campbell, Institutional analysis and the role of ideas in political economy, Theory Soc. 27 (3) (1998) 377–409.
[7] J.L. Campbell, O.K. Pedersen, Policy ideas, knowledge regimes and comparative political economy, Soc. Econ. Rev. Adv. Access 2015 (April) (2015), http://dx.doi.org/10.1093/ser/mwv004.
[8] N. Carter, M. Jacobs, Explaining radical policy change: the case of climate change and energy policy under the British labour government 2006–10, Publ. Adm. 92 (1) (2014) 125–141.
[9] CMA (Competition and Markets Authority), Energy Market Investigation: Case studies on Barriers to Entry and Expansion in the Retail Supply of Energy in Great Britain, CMA, London, 2015.
[10] M. Crepaz, Inclusion versus exclusion—political institutions and welfare expenditures, Comp. Polit. 31 (1) (1998) 61–80.
[11] C. Crouch, Models of capitalismls of capitalism, New Polit. Econ. 10 (4) (2005) 439–456.
[12] E. Davey, Edward Davey politics home article: keeping the lights on and the air clean, Polit. Home (Sepember) (2012).
[13] DECC (Department of Energy and Climate Change), Implementing the Wood Review Recommendations, TSO, London, 2015.
[14] L. Di Lucia, K. Ericsson, Low-carbon district heating in Sweden—examining a successful energy transition, Energy Res. Soc. Sci. 4 (2014) (2014) 10–20.
[15] EC (European Commission), Consolidated version of the treaty on the functioning of the European union, Off. J. Eur. Union (2010), 30.3.2010/C 82/49.
[16] A. Evrard, Political parties and policy change: explaining the impact of French and German greens of energy policy, J. Comp. Policy Anal. Res. Prac. 14 (4) (2012) 275–291.
[17] F. Fischer, Reframing Public Policy: Discursive Politics and Deliberative Practices, OUP, Oxford, 2003.
[18] R. Fouquet, The slow search for solutions: lessons from historical energy transitions by sector and service, Energy Policy 38 (2010) 6586–6596.
[19] T.J. Foxon, A coevolutionary framework for analysing a transition to a sustainable low carbon economy, Ecol. Econ. 70 (2011) 2258–2267.
[20] G. Fuchs, N. Hinderer, G. Kungl, M. Neukirch, Adaptive Capacities Path Creation and Variants of Sectoral Change: The Case of the Transformation of the German Energy Supply System, SOI Discussion Paper, 2012, 2012-02.
[21] F. Geels, Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study, Res. Policy 31 (2002) 1257–1274.
[22] F. Geels, Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective, Res. Policy 39 (2010) 495–510.
[23] F. Geels, Regime resistance against low-carbon transitions: introducing politics and power into the multi-level perspective, Theory Cult. Soc. 31 (5) (2014) 21–40.
[24] F. Geels, J. Schot, Typology of sociotechnical transition pathwayslogy of sociotechnical transition pathways, Res. Policy 36 (2007) 399–417.
[25] A. Giddens, The Politics of Climate Change, Polity Press, Cambridge, 2009.

[26] A. Hadfield, Energy and foreign policy: EU-Russia energy dynamics, in: S. Smith, A. Hadfield, T. Dunne (Eds.), Foreign Policy: Theories, Actors, Cases, Oxford University Press, Oxford, 2008.
[27] P.A. Hall, Policy paradigms, social learning, and the state: the case of economic policymaking in Britain, Comp. Polit. 25 (3) (1993) 275–296.
[28] P.A. Hall, D. Soskice, Varieties of Capitalism: The Institutional Foundations of Comparative Advantage, O. U. P, Oxford, 2001.
[29] P.A. Hall, R.C.R. Taylor, Political science and the three new institutionalismstical science and the three new institutionalisms, Polit. Stud. 44 (1996) 936–957.
[30] P.A. Hall, K. Thelen, Institutional change in varieties of capitalismitutional change in varieties of capitalism, Soc. Econo. Rev. 7 (1) (2009) 7–34.
[31] C. Hay, D. Wincott, Structure, agency and historical institutionalismcture, agency and historical institutionalism, Polit. Stud. XLVI (1998) 157–177.
[32] C. Hay, Ideas, interests and institutions in the comparative political economy of great transformationss, Rev. Int. Polit. Econ. 11 (1) (2004) 204–226.
[33] C. Hay, Narrating crisis: the discursive construction of the winter of discontent, Sociology 30 (2) (1996) 253–277.
[34] D. Helm, The assessment: the new energy paradigmassessment: the new energy paradigm, Oxford Rev. Eco. Policy 21 (1) (2005) 1–18.
[35] IMF , How Large are Global Energy Subsidies? IMF Working Paper Wp/15/105, (2015).
[36] IPCC, Climate change 2014, in: R.K. Pachauri, L.A. Meyer (Eds.), Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC, Geneva, Switzerland, 2014.
[37] T. Iversen, D. Soskice, Electoral institutions and the politics of coalitions: why some democracies redistribute more than others, Am. Polit. Sci. Rev. 100 (2006) 165–181.
[38] S. Jacobsson, V. Laubner, The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology, Energy Policy 34 (2006) (2006) 256–276.
[39] C. Julian, Creating Local Energy Economies: Lessons from Germany, ResPublica Essay, 2014, 24th July 2014. vailable at: http://www.respublica.org.uk/our-work/publications/creating-local-energy-economies-lessons-germany/ (accessed 16.12.15).
[40] R. Kemp, J. Schot, R. Hoogma, Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management, Technol. Anal. Strategic Manage. 10 (1998) 175–195.
[41] R. Kemp, A. Rip, J.W. Schot, Constructing transition paths through the management of niches, in: R. Garud, P. Karnoe (Eds.), Path Dependence and Creation, Lawrence Erlbaum, Mahwah, NJ, 2001.
[42] F. Kern, M. Howlett, Implementing transition management as policy reforms: a case study of the Dutch energy sector, Policy Sci. 42 (4) (2009) 391–408.
[43] F. Kern, C. Kuzemko, C. Mitchell, Measuring and explaining policy paradigms change: the case of UK energy policy, Policy Polit. 42 (4) (2014) 513–530.
[44] C. Kuzemko , Energy Governance, Suppliers and Demand Side Management EPG Working Paper No. 1503, (2015). Available at: http://projects.exeter.ac.uk/igov/working-paper-energy-governance-suppliers-and-demand-side-management/ (Accessed 16.12.16).
[45] C. Kuzemko, The Energy Security-Climate Nexus: Institutional Change in the UK and Beyond, Palgrave Macmillan, Hampshire and New York, 2013.
[46] E. Lachapelle, M. Paterson, Drivers of national climate policy, Clim. Policy 13 (5) (2013) 547–571.
[47] E. Lieberherr, B. Truffer, The impact of privatisation on sustainability transitions: a comparative analysis of dynamic capabilities in three water utilities, Environ. Innov. Soc. Trans. 15 (2015) 101–122.
[48] M. Lockwood, The political dynamics of green transformations: feedback effects and institutional context, in: I. Scoones, M. Leach, P. Newell (Eds.), The Politics of Green Transformations, Routledge, London and New York, 2014.
[49] J. Mahoney, K. Thelen, A theory of gradual institutional change, in: J. Mahoney, K. Thelen (Eds.), Explaining Institutional Change: Ambiguity, Agency and Power, Cambridge University Press, Cambridge, 2010.
[50] A. Månsson, Energy, conflict and war: towards a conceptual framework, Energy Soc. Sci. 4 (2014) (2014) 106–116.
[51] J. Markand, R. Raven, B. Truffer, Sustainability transitions: an emerging field of research and its prospectsainability, Res. Policy 41 (2012) 955–967.
[52] J. Meadowcroft, Environmental political economy, technological transitions and the stateronmental political economy, technological transitions and the state, New Polit. Econ. 10 (4) (2005) 479–498.
[53] James Meadowcroft, Engaging with the politics of sustainability transition, Environ. Innov. Soc. Trans. 1 (2011) 70–75.
[54] J. Mikler, N. Harrison, Varieties of capitalism and technological innovation for climate change mitigation, New Polit. Econ. 17 (2) (2011) 179–208.
[55] C. Mitchell, The Political Economy of Sustainable Energy, Palgrave Macmillan, Basingstoke and New York, 2008.
[56] R. Nelson, S. Winter, An Evolutionary Theory of Economic Change, Bellknap Press, Cambridge, MA, 1982.
[57] P. Newell, M. Paterson, Climate Capitalism: Global Warming and the Transformation of the Global Economy, Cambridge University Press, Cambridge, 2010.
[58] D. Painter, Oil, Encyclopaedia Am. Foreign Policy 2 (3) (1997) 1–20.
[59] C. Perez, Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages, Edward Elgar, Cheltenham, 2002.
[60] R. Raven, F. Kern, B. Verhees, A. Smith, Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases, Environ. Innov. Soc. Trans. (2015) http://dx.doi.org/10.1016/j.eist.2015.02.002.
[61] A. Rip, R. Kemp, Technological change, in: S. Rayner, E.L. Malone (Eds.), Human Choice and Climate Change, vol. 2, Battelle Press, Columbus, OH, 1998, pp. 327–399.
[62] J. Rotmans, R. Kemp, M. van Asselt, More evolution than revolution: transition management in public policy evolution than revolution: transition management in public policy, Foresight 3 (1) (2001) 15–31.
[63] I. Rutledge, UK energy policy and market fundamentalism: a historical overview, in: I. Rutledge, P. Wright (Eds.), UK Energy Policy and the End of Market Fundamentalism, O.U.P, Oxford, 2010.
[64] A. Schaffrin, S. Sewerin, S. Seubert, The innovativeness of national policy portfolios-climate policy change in Austria, Germany and the UK, Environ. Polit. 23 (5) (2014) 860–883.
[65] V. Schmidt, Taking ideas and discourse seriously: explaining change through discursive institutionalism as the fourth new institutionalism, Eur. Polit. Sci. Rev. 2 (1) (2010) 1–25.
[66] V. Schmidt, The Futures of European Capitalisms, OUP, Oxford, 2002.
[67] H. Schmitz, Green transformation: is there a fast track? in: I. Scoones, M. Leach, P. Newell (Eds.), The Politics of Green Transformations, Routledge, Oxford and New York, 2015.
[68] M. Schreurs, The politics of a phase-out Bull. Atom. Sci. 68 (6) (2012) 30–41.
[69] T. E. Schüppe, The German Energiewende turn around Policy Framework (Part II), Observer Research Foundation, 11: 34 (2015). Available at: http://www.orfonline.org/cms/sites/orfonline/modules/enm-analysis/ENM-ANALYSISDetail.html?cmaid=78428&mmacmaid=78429 (accessed 16.12.15).
[70] I. Scrase, A. Smith, The (non-) politics of managing low carbon socio-technical transitions, Environ. Polit. 18 (5) (2009) 707–726.
[71] I. Scrase, T. Wang, G. MacKerron, F. McGowan, S. Sorrell, Introduction: climate policy is energy policy, in: Ivan Scrase, Gordon MacKerron (Eds.), Energy for the Future: A New Agenda, Palgrave Macmillan, Basingstoke and New York, 2009.
[72] E. Shove, G. Walker, CAUTION! transitions ahead: politics, practice and sustainable transition management, Environ. Plan. A 39 (2007) 763–770.
[73] E. Shove, G. Walker, Governing transitions in the sustainability of every day life, Res. Policy 39 (2010) 471–476.
[74] A. Smith, R. Raven, What is a protective space? Reconsidering niches in transitions to sustainability, Res. Policy 41 (2012) (2012) 1025–1036.
[75] A. Smith, A. Stirling, F. Berkhout, The governance of sustainable socio-technical transitions, Res. Policy 34 (2005) 1491–1510.
[76] A. Smith, J.-P. Voß, J. Grin, Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges, Res. Policy 39 (4) (2010) 435–448.
[77] B. Sovacool, What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda, Energy Res. Soc. Sci. 1 (2014) 1–29.
[78] T. Stenzel, A. Frenzel, Regulating technological change: the strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets, Energy Policy 36 (2008) 2645–2657.
[79] A. Stirling , Emancipating rransformations: From controlling the transition to culturing plural radical progress, Steps Centre 2014; ISBN: 978-1-78118-170-6ISBN: 978-1-78118-170-6 (2014).
[80] S. Strange, States and Markets, Pinter, London, 1988.
[81] K. Sühlsen, M. Hisschemöller, Lobbying the energiewende assessing the effectiveness of strategies to promote the renewable energy business in Germany, Energy Policy 69 (2014) (2014) 316–325.
[82] D. Toke, V. Laubner, Anglo-Saxon and German approaches to neoliberalism and environmental policy: the case of financing renewable energy, Geoforum 38 (2007) (2006) 677–687.
[83] B. Turnheim, F.W. Geels, Regime destabilisation as the flipside of energy transitions: lessons from the history of the British coal industry (1913–1997), Energy Policy 50 (2012) (2012) 35–49.
[84] G. Unruh, Understanding carbon lock-inrstanding carbon lock-in, Energy Policy 28 (2000) 817–830.
[85] G.P.J. Verbong, D. Loorbach, Introduction, in: G. Verbong, D. Loorbach (Eds.), Governing the Energy Transition: Reality Illusion or Necessity?, Routledge, Oxford and New York, 2012.
[86] R. Willis, N. Eyre, Demanding Less: Why We Need a New Politics of Energy, Green Alliance, London, 2011.
[87] P. Bertoldi, Boza-KissB, S. Panev, N. Labanca, ESCO Market Report 2013, Publications Office of the European Union, Luxembourg, 2014, ISBN: 978-92-79-38646-6.
[88] T. DiMuzio, Capitalizing a future unsustainable: finance, energy and the fate of market civilization, Rev. Int. Polit. Econ. 19 (3) (2012) 363–388.
[89] M. Murphy, Interests, institutions and ideas: explaining Irish social security policy, Policy Polit. 40 (3) (2012) 347–365.